Monitoring of Indian National Aquatic Resources
Series : MINARS/03/2009

Gandhi Memorial College Of Education Bantalab Jammu

WATER QUALITY MONITORING OF TAWI RIVER

FOR THE YEAR 2007-08

J&K
SPCB

J&K STATE POLLUTION CONTROL BOARD

'Parivesh Bhawan', Gladini, Narwal, Jammu - 180006 (J&K)

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Dated 10.12.18

Water Quality Monitoring of Tawi River

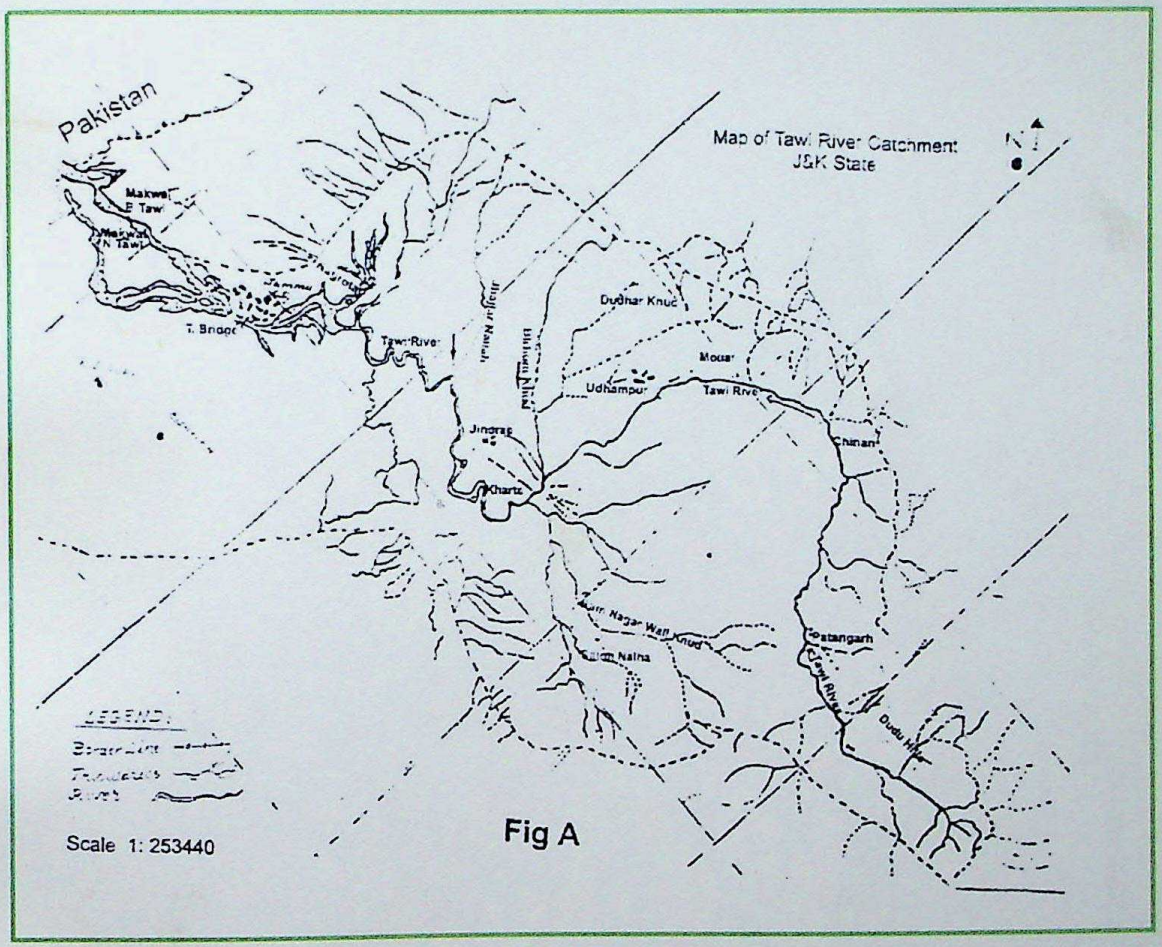

Fig A

2007-08

J&K STATE POLLUTION CONTROL BOARD

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Message

Commissioner / Secretary to Govt.
Forests Department
J&K Government
Jammu / Srinagar

It gives me immense pleasure to know that all the major rivers, lakes, ponds and dams of Jammu and Kashmir are being monitored by Jammu & Kashmir State Pollution Control Board through its Regional laboratories to have a strict vigil on the quality of water and provide information to concerned department for remedial measures.

Water is elixir of life and all the drinking water sources have to maintain in such a manner that its contamination due to sewage or industrial pollution does not effect the health of living beings.

This report on the monitoring of water quality of Tawi river is an attempt by the State Pollution Control Board to regularly test the quality of water so that drinking water supplied to city of Jammu is safe. I am sure that it will contribute to a greater extent in widening the horizons of knowledge made to improve the water quality of this river.

I congratulate the State Pollution Control Board for undertaking this work through its Jammu laboratory and hope that its findings will guide local authorities in addressing the serious issue of pollution of River Tawi.

(Shant Manu) IAS

No. : FST/PCB/12/09-M
Dated : 12-3-2009

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FOREWORD

Water quality monitoring is one of the first steps required in the rational development and management of water resources. The monitoring comprises all the activities to obtain information with respect to the water system. It is an important pre-requisite exercise, which helps to know the nature and extent of pollution to which a particular water body is subjected to and remedial measures required to restore it.

River Tawi is an important tributary of river Chenab, originating from lesser Himalayan Hills/ Dudu Hills. It moves through Pattangarh, Chenani ,Udhampur ,Kharta, Kishanpur- Manwal ,Jindrah, Nagrota, Jammu city ,Belicharana ,Suraj Pur, Makwal and finally meets the river Chenab near Marala in Pakistan. Earlier the monitoring on this River was conducted in 2003. During the year 2005-06 various initiatives have been taken for monitoring and control of pollution from different sources. The water quality of this river has been monitored during Nov- Dec 2007-08 for assessment of pollution load. The details of Parameters monitored, the Methodology followed and the finding along with observation about the pollution level and the recommendations have been compiled and brought out in this report. I hope this publication will be of great help in formulating water management plan of Tawi Watershed area and will also create awareness about water borne diseases. Hard work done by Dr Yash Paul Scientist-B, SPCB and his team of scientists, in preparation of this document is highly appreciated.

Dr C. M Seth, IFS
Chairman

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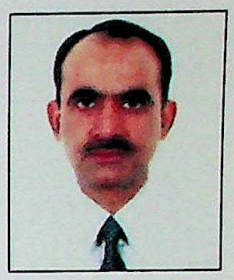

PREFACE

Rivers have got very important place in Indian culture and tradition. They are the lifeline of majority of population in cities, towns and villages and most of these are considered sacred. The concept of water quality monitoring has been initiated with the identification of beneficial use of water in terms of primary water quality criteria. For maintaining the quality of river water, the pollution level in rivers have been detected by monitoring limited number of physico- chemical parameters, which could only determine the changes in chemical characteristics of water bodies. The water Act, 1974 is to maintain and restore the wholesomeness of river water in terms of their ecological sustainability.

River Tawi an important tributary of river Chenab has its origin from Middle Himalayas, flows through middle mountains along Dudu, Chapar, Marothi, Chenani, Udhampur, Jammu and finally meets with river Chenab near Marala in Pakistan.

The water quality of this river has been monitored to know the nature and extent of pollution to which a particular water body is subjected and remedial measures required to restore it. I hope, this exercise will be of great use and helpful in making future action plan on River Tawi.

Dr. Mohit Gera, IFS
Member Secretary

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Data Operator	:	Mrs. Princy Thaploo

SPCB Water Laboratory

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Water Quality Monitoring of Tawi River

1. INTRODUCTION

1.1 Background of the Project

River water monitoring is an important exercise which helps in evaluating the nature and extent of pollution, the pollution control measures required and the effectiveness of pollution control measures already in existence. Other objectives of water quality monitoring may be summarized as:

- For rational planning of water pollution control strategies and their prioritization.
- To evaluate water quality trends over a period of time.
- To assess assimilative capacity of water body.
- To assess fitness of water for different uses.
- To understand environmental fate of different pollutants.

Like any other water body river Tawi also faces contamination due to discharge of effluents/sewage at various points.

Water is essential for life on earth and is always talk of the town either due to too much of it or too little of it. Water, with a deceptively simple chemical formula of H_2O, is a vitally important substance in all parts of the environment Water covers about 70% of the earth's surface. Water is an essential part of all living systems and is the medium from which life evolved and in which life exists.

Excluding chemically found water, the total amount of water on earth is about 1.4 billion cubic kms (1.4×109 km^3). Out of this, 97.6% is present as salt water in earth's oceans. This leaves about 33 million km^3 to be distributed elsewhere on earth. Even of this amount about 87% is present in solid form, predominantly as polar snowcaps and another 12% as groundwater. Just over 1% of all earth's fresh water is distributed among surface water, atmospheric water and biospheric water. This very small fraction comprises water in lakes, vast rivers, groundwater to a depth of 1 km, water in the atmosphere and water in the biosphere.

Indian sub-continent is one of the wettest places on earth. In India, rivers play an important role in its culture and tradition. Most of the rivers in India are considered sacred due to their mythological background.

There are no major differences between the rivers but for any one river, the chemical

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composition may vary at different times and at different places since water quality is highly susceptible to spatial and temporal variability.

Since rivers have been the nucleus of development of various civilizations, the quality of water in practically all rivers across various continents have deteriorated with respect to a number of parameters. Since time immemorial river water has been used for drinking, bathing, municipal supply, irrigation purposes etc. It is now a days also being used as a receptacle for discharge of industrial effluents, municipal sewage and dumping of solid waste thereby leading to its pollution.

The water quality is critical to the sustainability of aquatic habitats, food webs and commercial fisheries that serve as a major protein source for human beings. The contaminants in the aquatic systems are hazardous to the human beings, cattle, aquatic birds, fishery resources and other biotic components. There are three properties of water that has bearing on its quality-physical, chemical and biological. Colour, odour and turbidity are the important physical properties. Water has to be clear/odourless and with no visible particles floating around. Since more than 70% of all diseases in India are water born. The microbiological properties of water should meet suitable requirements under different health criteria. The physical, microbiological and chemical properties of drinking water should be within acceptable limits for domestic use as stipulated by various agencies such as Indian standard Institution (ISI) CPCB, WHO, united states environmental Protection Agency (US-EPA) and Others.

1.2 Geography and Hydrology of River Tawi

River Tawi, an important tributory of river Chenab originates from one of the Himalayan glaciers which after moving through various steps in Jammu Division finally meets the river Chenab in Pakistan.

Since time immemorial, Himalayas have over 15,000 glaciers which cover an area of about 33,000 sq.Kms thereby holding an enormous amount of fresh water in it in the form of snow and ice.

River Tawi an important tributary of river Chenab, originates from the southern part of lesser Himalayan hills (Bhaderwah Dudu hills) and is joined by number of tributaries on its way. After moving through Patangarh, Chenani, Mauor, Udhampur, Kharta, Jindrah, Nagrota, Jammu City, Belicharana, Surajpur and Makwal, it ultimately meets the river Chenab near Marala in Pakistan.

1.3 Pollution in River Tawi

a) Sewage Pollution

Sewage is wastewater generated from domestic activities including kitchen, bathroom, toilet and floor washing. It is basically an urban issue. In rural areas sewage is insignificant. Fast urbanization and increasing standards of living result in steep increase in generation of sewage in the Country. Due to paucity of resources the sewage is not properly collected and treated. Nearly 2/3rd of the pollution problem is due to discharge of untreated or partially treated sewage in our country.

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Water borne diseases are "dirty-water" diseases - those caused by water that has been contaminated by human, animal, or chemical wastes. These include cholera, typhoid, shigella, polio, meningitis, and hepatitis A and E. Human beings and animals can act as hosts to the bacterial, viral, or protozoal organisms that cause these diseases. Millions of people have little access to sanitary waste disposal or to clean water for personal hygiene.

b) Pollution from Municipal dumping sites and drains

Water pollution is a problem of great importance and is of everybody's concern. It can be defined as the "undesirable change in the physical, chemical or biological characteristics of our water". This change may or will harmfully affect human life or that of desirable species, our industrial processes, living conditions and cultural assets. It may or will waste or deteriorate our raw material resources. Pollutants are the residues of the things of matter we make use of, they may be degradable/non-degradable, may be solid wastes, liquid wastes and wastes in the form of residues resulting in the disturbance and bringing health hazards to living beings.

In the survey conducted to assess pollution in river Tawi downstream, the first dumping site was seen about 1500 mts from Sidhra Bridge. Heaps of clay, brick bits, municipal waste and dead animals were found lying at this site giving rise to foul smell. There are about twelve dumping sites on right side of river Tawi downstream from Sidhra Bridge and about twenty dumping sites on left side of river downstream from this bridge. Dumping sites at Bhagwati Nagar and Tawi Island can be considered as highly pollution causing sites. A Municipal drain about 2500 mtrs in length containing turbid water and wastes such as polythene bags and garbage from Pacci Dacci, Julaka Mohalla, Pir-Mitha and Pirkho area were seen; thereby polluting the river. An underground channel at Bhagwati Nagar near the office complex of Fisheries Department adjacent to back side of G.G.M. Science College enters into river Tawi with highly polluted sewerage, turbid water and municipal solid waste. These zones can be considered as the highly polluting zones. There are number of seasonal drains which remain mostly dry but flow during rainy seasons. Highly polluting dumping sites and municipal drains with high concentration of pollutants are given below :

Dumping Site No. 1, Near Sidhra, Bridge

S. No.	Parameter	Detail
1	Weather	Sunny
2	Approximate Depth of main stream	Two feet
3	Color and Odour	Odourless clear water
4	Visible effluent discharge/dumping	Solid municipal waste, heaps of clay, dead animals, polythene bags, garbage etc. was seen accumulated
5	Human activities around station	Lifting of sand, fishing, washing of trucks, dumping solid municipal waste of adjoining area.

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Dumping Site Near Sidhra, Bridge

Dumping Site No.2 Near Pirkho

S.No.	Parameter	Detail
1	Weather	Sunny
2	Approximate Depth of main stream	Two feet
3	Color and Odour	Unpleasant Odour with slight muddy water
4	Visible effluent discharge/dumping	Solid municipal waste, heaps of clay, polythene, garbage etc. was seen accumulated
5	Human activities around station	Lifting of sand, fishing, washing of trucks, dumping / disposal of solid municipal waste of adjoining area.

Dumping Site Near Pirkho

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Dumping Site No.3 Near Cremation Ground Bhagwati Nagar

S.No.	Parameter	Detail
1	Weather	Sunny
2	Approximate Depth of main stream	One feet
3	Color and Odour	Muddy water, unpleasant odour
4	Visible effluent discharge/dumping	Solid municipal waste, heaps of clay, polythene, garbage etc. was seen accumulated
5	Human activities around station	Lifting of sand, fishing, washing of trucks, dumping of solid municipal waste of adjoining area as well as oldest dumping site of Jammu Municipality. Presently, dumping has been stopped.

Dumping Site Near Cremation Ground Bhagwati Nagar

Municipal Drain No.1 Below Sher-e-Kashmir Bridge

S.No.	Parameter	Detail
1	Weather	Sunny
2	Approximate Depth of main stream	Two feet
3	Color and Odour	Unpleasant Odour with muddy, reddish water may be due to slaughter houses nearby.
4	Visible discharge/ dumping	Solid municipal waste, heaps of clay, polythene, garbage etc. seen accumulated
5	Human activities around station	Lifting of sand, fishing, dumping of disposal and discharge / solid municipal waste of adjoining area. (Residential Area nearby)

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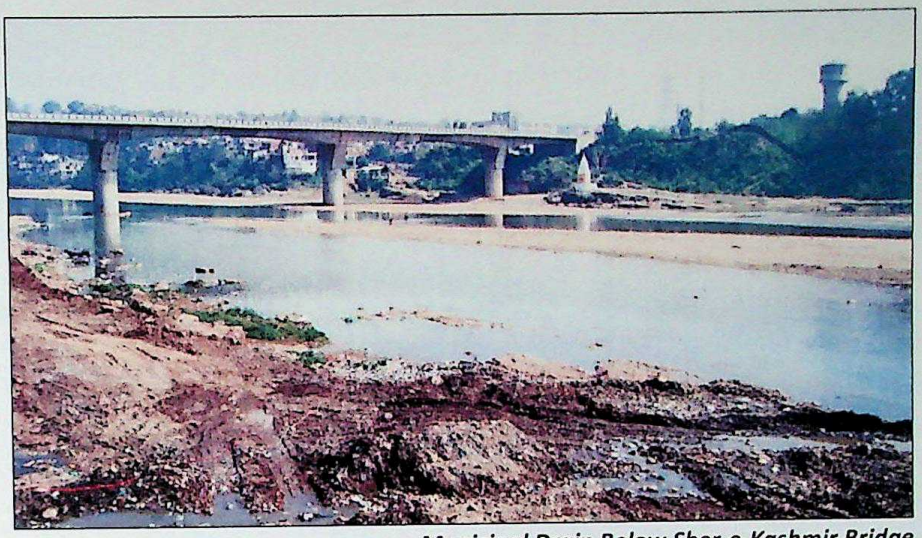

Municipal Drain Below Sher-e-Kashmir Bridge

Municipal Drain No.2 Near Fishery Deptt. Bhagwati Nagar

S.No.	Parameter	Detail
1	Weather	Sunny
2	Approximate Depth of main stream	One feet
3	Color and Odour	Muddy Water with unpleasant odour
4	Visible effluent discharge/dumping	Solid municipal waste, heaps of clay, polythene, garbage etc. were seen accumulated
5	Human activities around station	No human activity was seen around which may be because of foul smell.

Municipal Drain Near Fishery Deptt. Bhagwati Nagar

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In its upper catchment areas, it receives water from Snow covered mountains and a large number of tributaries Viz, Birhum Khud, Ramnagar wali Khud, Saloh nallah, Gambhir Khud, Jhajjar Nallah etc. and water along its course .Flow of river increases many times during monsoon but it is greatly reduced during summer months.

The origin of Tawi River from Dudu hills to its end course has vast risk of contamination from various effluents at each and every tributary or feeding channel, Similarly our permanent water bodies have endangered risk of pollution due to increasing domestic and other effluents draining in to them.

The flowing water has significant self-purification capacity, which is self purified and diluted during course of travel of river water to some distance. With increasing population and industrialization, the rivers are affected both in quality and quantity.

Due to construction of barrages, dams or development of irrigation canal network on rivers, the downstream stretches of river do not get enough water supply. As a result, the pollutants discharged through several drains, sewage drains and effluents from industries joining the rivers do not get diluted thereby affecting self purification capacity of the rivers and resulting in its pollution.

2. CONCEPT OF MONITORING

Indian Rivers are classified as major, medium and minor rivers depending upon the basin area. Rivers are the life line of majority of population in cities, towns, villages and most of these are considered sacred. During some festivals people take holy dip in rivers. Every river has a distinct water use like bathing, drinking, municipal supply, navigation, irrigation and fishing. Similarly, these are also used as receptacles for discharge of industrial effluents, municipal sewage and dumping of solid wastes. The water (Prevention and Control of Pollution) Act 1974 is aimed to support the water quality of various designated best uses of water bodies.

3 EXISTING WATER QUALITY

3.1 Water Quality Monitoring

River water quality monitoring is most essential aspect of restoring the water quality to assess the water quality of the river water, 14 sampling locations were selected from Kishanpur to Makwal near Indo- Pak Border (Table1) . Systematic monitoring of water quality at aforesaid selected sampling spots in the river Tawi was carried out during Nov.-Dec.2007-08. Earlier the monitoring for these spots was carried out during May - June and Oct - Nov 2003(Pre Monsoon and after Monsoon) and Oct -Nov 2005-06. To restore the river water quality, monitoring the level of pollution in it is very necessary. State pollution control Board has therefore taken several steps in this direction. The present one being one of them.

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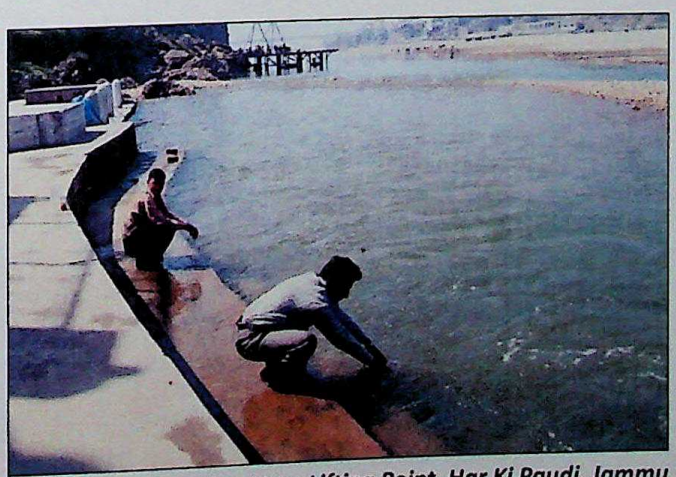
3.2 Water quality monitoring locations of River Tawi

Table - 1

Code No.	Name of site
T0	Kishan Pur
T1	Kishanpur Manwal
T2	Jhajjhar Nallah
T3	Nagrota (Near Sanik School)
T4	Nagrota Sheetali Near Filtration Point
T5	Lifting point (Bagh-e-Bahu)
T6	Cremation Ground (Near Tawi Bridge)
T7	Tawi Bridge
T8	Bhagwati Nagar (Badi Tawi)
T9	Beli Charana (Niki Tawi)
T10	Suraj pur (Niki Tawi)
T11	Makwal (Near Border Line-Niki Tawi)
T12	Makwal Badi Tawi
T13	Makwal (Near Border Line) Badi Tawi

The water samples as per above programme were analyzed in accordance with APHA(21st addition) standard methods for the Examination of Water & Waste Water) for the parameters indicated below:

Monitoring Location Below Tawi Bridge Jammu



Monitoring Location Near Lifting Point, Har Ki Paudi, Jammu

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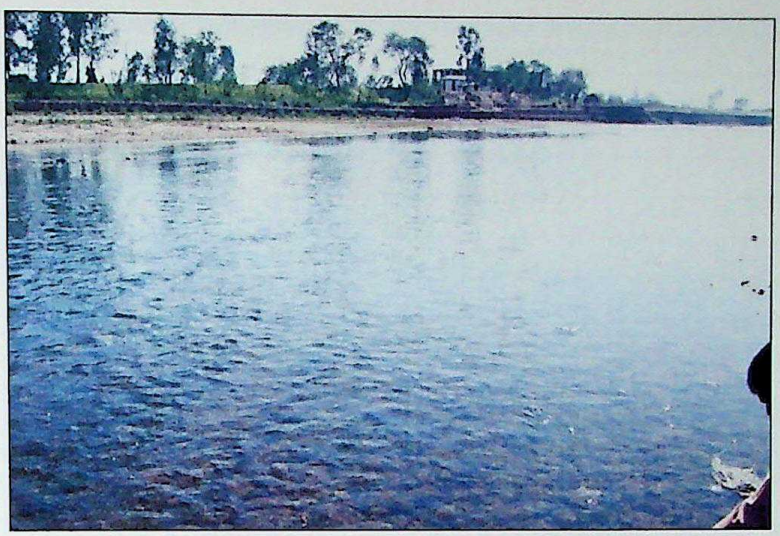
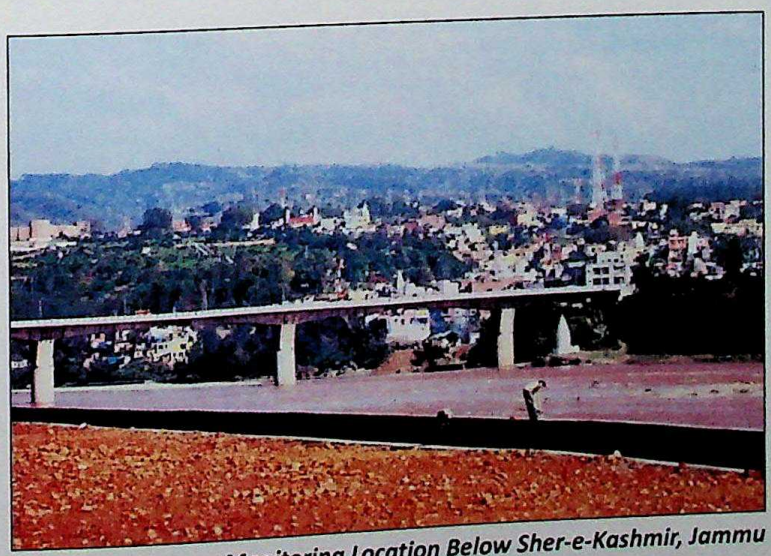


Monitoring Location Suraj Pur, Nikki Tawi, Jammu

Monitoring Location Near Cremation Ground, Jammu



Monitoring Location Below Sher-e-Kashmir, Jammu

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Table No. 2

S. No.	Parameters
1	Colour
2	Odour
3	pH (pH Units).
4	Temperature (Degree Celsius).
5	Turbidity (NT Units).
6	Conductivity (µmhos/cm).
7	Dissolved oxygen (DO mg/l).
8	Alkalinity (mg/l).
9	Total Hardness (as $CaCo_3$) mg/l.
10	Calcium (mg/l).
11	Magnesium (mg/l).
12	Chloride (as Cl)(mg/l).
13	Residual Chlorine (mg/l).
14	Suspended Solids (mg/l)
15	Dissolved Solids (mg/l).
16	Nitrate-N (mg/l).
17	Phosphate (mg/l)
18	Sulphate (as SO_4) mg/l
19	Ammonical Nitrogen (mg/l)
20	Nitrite-N (mg/l)
21	Sodium (as Na) mg/l

To discuss the water quality status in detail various parameters can be grouped as :

Table : 3

S.No.	Parameters	Indicators
1	Physical parameters	Temperture, Color, Odour, Temperature, Color, Odour, Suspended solid and Turbidity.
2	Mineral indicators	Conductivity , pH, Alkalinity, Total hardness, Calcium, Magnesium ,Chloride, Nitrate, Phosphate, Ammonical Nitrogen, Nitrite ,Sulphate Sodium, Potassium etc.
3	Indicators of Organic Pollution	Dissolved Oxygen (DO),Biological Oxygen Demand(BOD)

4. OBSERVED WATER QUALITY OF RIVER TAWI

4.1 MONITORING RESULTS

The Water Quality of River Tawi has been monitored during November-December 2007-08. The results of the various parameters discussed above are presented in Table-5.

The results of Table-5 are compared as :

(A) Physical Parameters

Temperature shows variation from one location to another. Temperature is found to vary

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from a maximum of 18.0º c to minimum of 14.0º C. Highest temperature has been found in Bhagwati Nagar (Badi Tawi) area and lowest temperature range has been found at T-4 i.e. Sheetali Nagrota Near Filtration plant.

(B) Parameters related to Minerals

pH : pH of a particular water sample depends on the type of geography (rocks & Minerals) ina catchment. It is measured immediately when the samples are brought in the laboratory. It ranges from 7.0 to 8.8 Higher pH values have been found in samples taken near Belicharana (Niki Tawi) which indicates that water of river Tawi is alkaline at this spot. Lower value of pH was noted in sample from Nagrota Sheetali Lifting point i.e. 7.0

(C) Conductivity

Conductivity is an important parameter which is a measure of total dissolved solids. It varies from a maximum of 699 umho/cm in Bhagwati Nagar (Badi Tawi) to 235 umho/cm in Surajpur (Niki Tawi). Total dissolved solids ranges from 84 mg/l (Kishanpur) to 398 mg/l (Tawi Bridge). Total suspended solids range from 236 mg/l (Kishanpur) to 1124 mg/l (Tawi Bridge). Total hardness varies from 110 mg/l (Belicharana) to 300 mg/l (Jaghar Nallah). Calcium and Magnesium concentrations vary from 28.0 mg/l (Belicharana to 104 mg/l (Jajjar Nallah) and 6.80 mg/l (Cremation Ground) Makwal & Kishanpur to 20.89 mg/l (Bhagwati Nagar) respectively, such concentrations of Total hardness, calcium and magnesium are within the safe limits and satisfy the grouping criteria and water of river Tawi can be grouped under Class A.

(D) Alkanity

Alkalinity of Water is referred to its qualitative capacity to neutralize an acid to designated pH. Alkalinity value ranges from 124 mg/l in Surajpur (Nikki Tawi) to 320 mg/l (Bhagwati Nagar) . Chloride concentration has been found to vary from minimum concentration of 7.0 mg/l (Tawi Bridge and Belilcharana) to maximum conc.of 30.5 mg/l (Bagwati Nagar). Concentration of chloride is quite satisfactory to put the river water under best class. Concentration of Iron ranges from 0.2 mg/l at various locations to 0.4 mg/l at Kishenpur. Phosphate concentration ranges from 0.0 mg/l (Belicharana) to 6.0 mg/l at Nagrota Sheetali near filteration point.

(E) Sulphate

Sulphate ions occur in natural water due to Oxidation of sulphite ores, dissolution of gypsum or due to addition of industrial waste. Value of sulphate ranges from 3.3 mg/l (Surajpur Niki Tawi) to 20.85 mg/l (Makwal near border line Niki Tawi) which fall within standard permissible range of 250 mg/l.

(F) Nitrite

Nitrite in water is present due to oxidation of ammonium compounds or due to reduction of nitrate. In natural water it is present in the range of some tenths of mg/l. Higher concentrations are present in industrial wastes sewage or in polluted streams. The value of nitrite ranges from 0.004 (Nagrota Sheetali lifting point and Belicharna to 1.009 mg/l) Lifting point Bagh-e-Bahu and Tawi Bridge).

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(G) Ammonical Nitrogen

Ammonia is produced by microbiological degradation of organic nitrogenous matter. Higher concentration are found due to sewage/Industrial waste. Its value ranges from .003(Cremation ground near River Tawi Bridge to 0.428 mg/l (Makwal Badi Tawi).

(H) Parameter related to organic pollution

1) Dissolved Oxygen(DO)

The dissolved oxygen (DO) level in natural and waste water depends on the Physical, Chemical and Bio chemical activities in water body. Rivers having DO of 4.0 mg/l or more are considered to be healthy. Dissolved oxygen ranges from 1.2 mg/l (Bhagwati Nagar Badi Tawi) 10.6 mg/l Jajjar Nallh. Except at Bhagwati Nagar, DO level satisfies the criteria for water quality of class A putting water quality at this location under class E.

2) Biological Oxygen Demand (BOD)

BOD is an important indicator of organic pollution. It checks the pollution load of water body/Industrial effluents etc. The values of BOD range from 0.46 mg/l at TO (Kishenpur) to 48 mg/l at T-8 (Bhagwati Nagar) Badi Tawi) showing highest pollution load at T-8.

5 SUMMARY

Sampling Location T-8 i.e. Bhagwati Nagar is the most polluted spot among all the 14 different locations. Prescribed limits of BOD (As per BIS 1982) for inland water surface falling in class A is 2 mg/l where as samples from Bhagwati Nagar shows a very high BOD of 48 mg/l. Rivers having D.O. of 4 mg/l or more are considered to be healthy where as sample from T-8 location shows D.O. of 1.2 mg/l. Also high values of minerals indicating parameters like conductivity, alkalinity, hardness, calcium and Magnesium, Phosphate etc has been reported at this spot. Unfavourable results in some of the parameters at spot T-7 (Below Tawi Bridge) T-11(Makwal-Nikki Tawi) T-12 (Makwal Badi Tawi), T-13, Makwal Badi Tawi, T-5 (lifting point Bagh-e-Bahu) T-6 (cremation Ground) were obtained.

Thus, the overall quality of the river can be considered as poor.

6 RECOMMENDATIONS

1. The project allotted to UP Jal Nigam for the construction of Sewage treatment Plant at Bhagwati Nagar Jammu to treat the sewerage waste generated from Jammu city may be taken on Priority to tackle the Pollution Problem.
2. Sewage Treatment Plant of Government Medical College Jammu should be made functional on regular basis.
3. Waste water of the city should be properly treated before its discharge into river Tawi.
4. People who contribute waste water should be a party right from planning, construction to operation and maintenance of treatment facilities which should come in function in near future.
5. Segregation and re-use of waste water should be encouraged.
6. Polluters pay principle should be adopted for Operation and Maintenance of treatment plants.

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7. Sewage fed rivers / ponds in relevant centres may be converted to decentralized sewage treatment system so that water quality of rivers / ponds be improved.
8. Use of EIA / EMP tool for township and residential colonies also be encouraged applicable to individuals and community activities.
9. Consent to Establish to be made mandatory for new township or residential colonies on the line of Industry while keeping in view the necessity of river / water body under Environment Protection Act,1986.
10. The designers and the builders for sewerage / drainage system should be made responsible for treatment and utilization of waste waters on long-term basis.
11. Dumping of solid municipal waste by municipal authorities at Bhagwati Nagar and Chatha near Surajpur bridge should be stopped because these sites are just at the bank of river Tawi.
12. Economic Reconstruction Agency (ERA) should be requested to make early channelisation for sewerage generated from Jammu city.
13. Civil society should also be made aware of the need to keep the river clean.
14. Monitoring of river water should be carried on regular basis to check the rise in persistent pollutants. ERA should finance UEED or PHE to set up two labs near Sidhra bridge and near Bhagwati Nagar to monitor water quality of River Tawi.

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TABLE-4

Physico -Chemical Status at various Locations in River Tawi (Nov-Dec. 2007-08)

A) Physical Parameters	Parameters	Locations T0	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	Max Limit	Min Limt
	colour	colour less	colour less	colour less	colour less	slightly pail	colour less	slightly pail	colour less	slightly pale	colour less	colour less	colour less	colour less	colour less	-	-
	odour	odour less	odour less	unpleas ant	odour less	slightly pail	odour less	odour less	odour less	pungent odour	odour less	odour less	odour less	odour less	odour less	-	-
	Temp	15.20	15.70	15.90	14.2ºC	14ºC	17ºC	17ºC	17ºC	18ºC	17ºC	17ºC	15.6ºC	16ºC	15.8ºC	18ºC	14ºC
	Turbidity(NTu)	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
B) Mineral Indicators	pH	8.10	7.90	7.50	7.60	7.00	7.80	7.50	8.30	7.40	8.80	8.70	7.50	8.10	7.90	8.80	7.00
	Conductivity (µmho/cm)	314.00	339.00	302.00	328.00	325.00	305.00	340.00	313.00	699.00	248.00	235.00	694.00	327.00	301.00	699.00	235.00
	Total Alkalinity(mg/l)	192.00	189.00	200.00	170.00	180.00	176.00	205.00	168.00	320.00	136.00	124.00	276.00	240.00	236.00	320.00	124.00
	Total Hardness (mg/l)	140.00	170.00	300.00	160.00	164.00	152.00	148.00	146.00	280.00	110.00	114.00	180.00	230.00	220.00	300.00	110.00
	Calcium(mg/l)	44.80	32.50	104.00	48.00	49.60	48.00	48.00	42.40	77.60	28.00	30.40	60.80	73.60	72.00	104.00	28.00
	Magnesium(mg/l)	6.80	9.72	9.72	9.72	9.72	7.70	6.80	9.72	20.89	9.72	9.23	6.80	11.17	9.72	20.89	6.80
	Chloride(mg/l)	13.00	14.40	11.00	9.50	8.00	9.00	8.50	7.00	30.50	7.00	8.50	13.00	14.00	12.50	30.50	7.00
	Total Dissolved Solid (mg/l)	84.00	98.00	148.00	192.00	271.00	294.00	382.00	398.00	364.00	228.00	196.00	211.00	126.00	194.00	398.00	84.00
	Suspended Solids (mg/l)	236.00	292.00	474.00	451.00	612.00	916.00	945.00	1124.00	1104.00	695.00	591.00	614.00	326.00	604.00	1124.00	236.00
	Iron (mg/l)	0.40	0.30	0.20	0.30	0.30	0.20	0.20	0.20	.3.	0.30	0.20	0.10	0.20		0.40	0.10
	Sulphate (mg/l)	10.20	11.50	8.40	9.00	9.20	12.00	13.50	11.85	11.10	5.10	3.30	20.85	16.95	16.45	20.85	3.30
	Nitrate (mg/l)	0.95	4.01	4.06	3.90	4.16	4.19	2.49	4.19	0.65	1.33	2.29	2.04	3.29	3.20	4.19	0.65
	Nitrite (mg/l)	0.03	0.02	0.02	0.02	0.00	1.01	0.31	1.01	0.02	0.00	0.55	0.24	0.54	0.54	1.01	0.00
	NH3-N	0.33	0.40	0.42	0.20	0.14	0.06	0.00	0.21	0.33	0.27	0.11	0.59	0.43	0.41	0.43	0.00
	PO4	0.02	0.03	0.02	0.01	6.00	0.01	0.14	0.02	1.08	0.00	0.01	0.24	0.15	0.16	6.00	0.00
c) Indicators of Organic Pollution	D.O	10.00	10.50	10.60	8.70	9.20	7.60	7.00	6.80	1.20	8.00	9.60	9.60	9.90	9.70	10.60	1.20
.	BOD	0.46	0.81	1.22	2.94	8.00	8.20	11.30	21.00	48.00	7.00	8.20	2.60	2.80	2.00	48.00	0.46
	Na	8.10	7.40	8.20	9.30	7.60	14.00	11.30	10.60	8.30	8.60	9.20	10.30	7.60	8.30	14.00	7.60
	K	6.20	2.90	2.00	1.80	1.20	1.10	1.00	2.00	2.80	2.60	2.80	3.20	3.80	4.00	4.00	1.00

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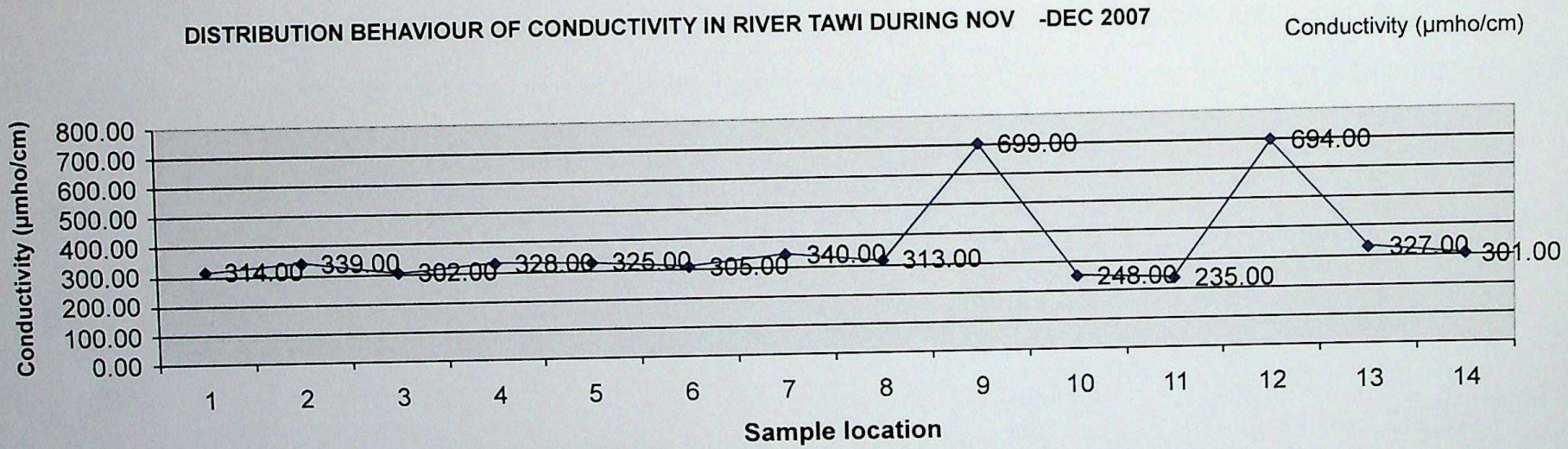
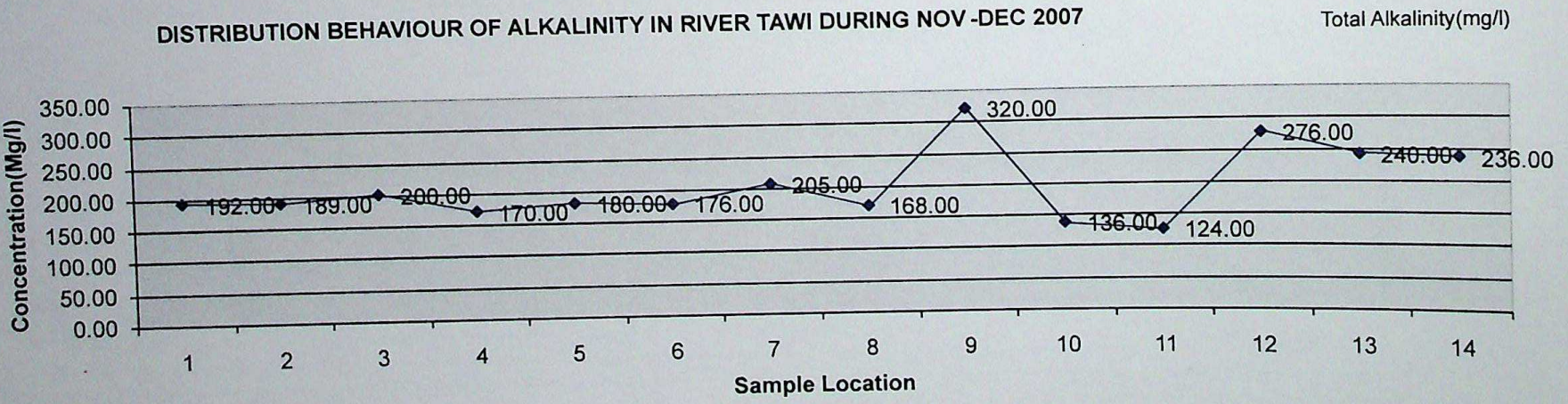
Annexure - 1





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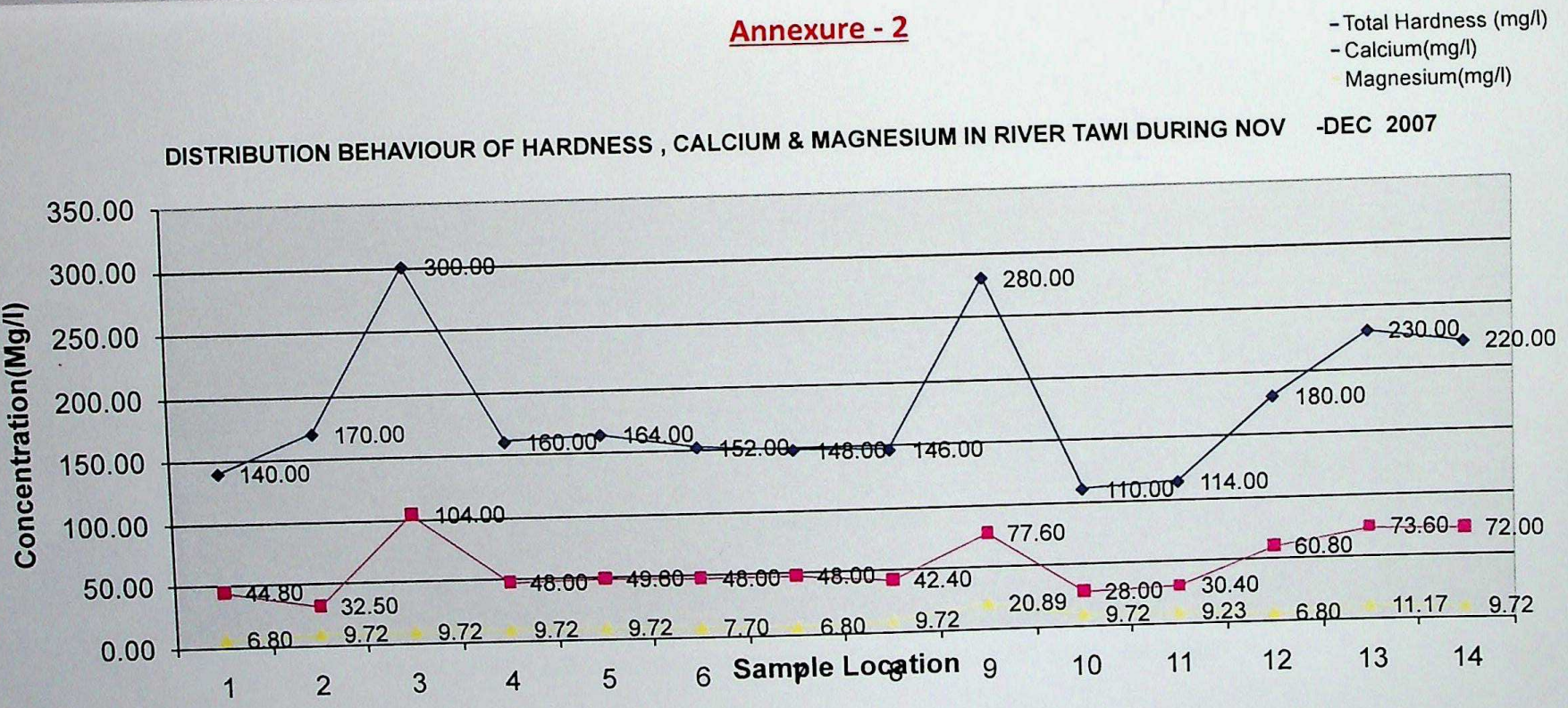
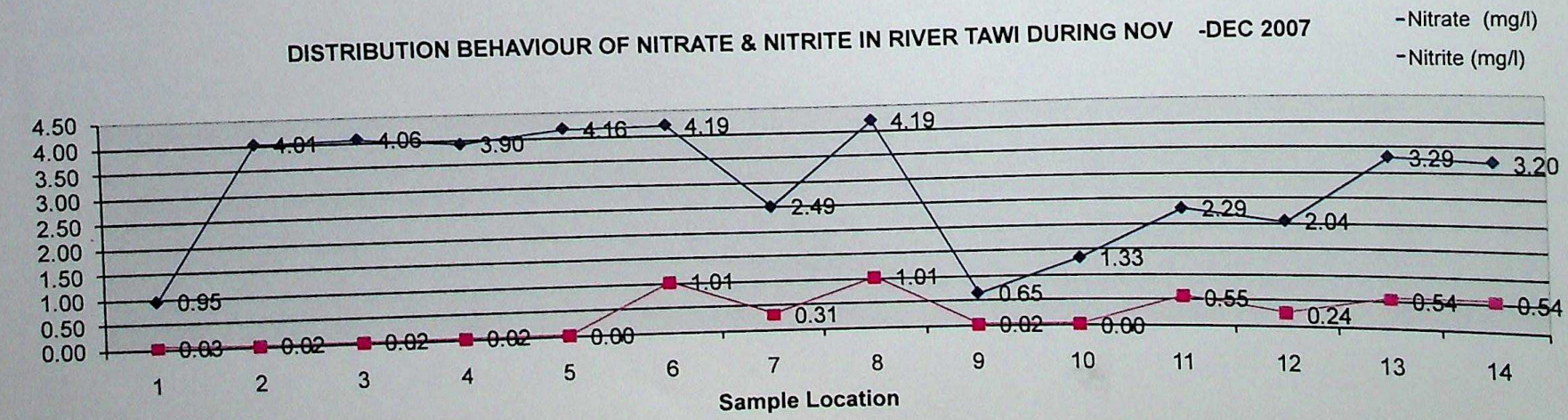
Annexure - 2


- Total Hardness (mg/l)
- Calcium(mg/l)
Magnesium(mg/l)
DISTRIBUTION BEHAVIOUR OF HARDNESS , CALCIUM & MAGNESIUM IN RIVER TAWI DURING NOV -DEC 2007
Concentration(Mg/l)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
140.00
170.00
300.00
160.00
164.00
152.00
148.00
146.00
280.00
110.00
114.00
180.00
230.00
220.00
44.80
32.50
104.00
48.00
49.60
48.00
48.00
42.40
77.60
28.00
30.40
60.80
73.60
72.00
6.80
9.72
9.72
9.72
9.72
7.70
6.80
9.72
20.89
9.72
9.23
6.80
11.17
9.72
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Sample Location


-Nitrate (mg/l)
-Nitrite (mg/l)
DISTRIBUTION BEHAVIOUR OF NITRATE & NITRITE IN RIVER TAWI DURING NOV -DEC 2007
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.95
4.01
4.06
3.90
4.16
4.19
2.49
4.19
0.65
1.33
2.29
2.04
3.29
3.20
0.03
0.02
0.02
0.02
0.00
1.01
0.31
1.01
0.02
0.00
0.55
0.24
0.54
0.54
1
2
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5
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7
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11
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13
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Sample Location

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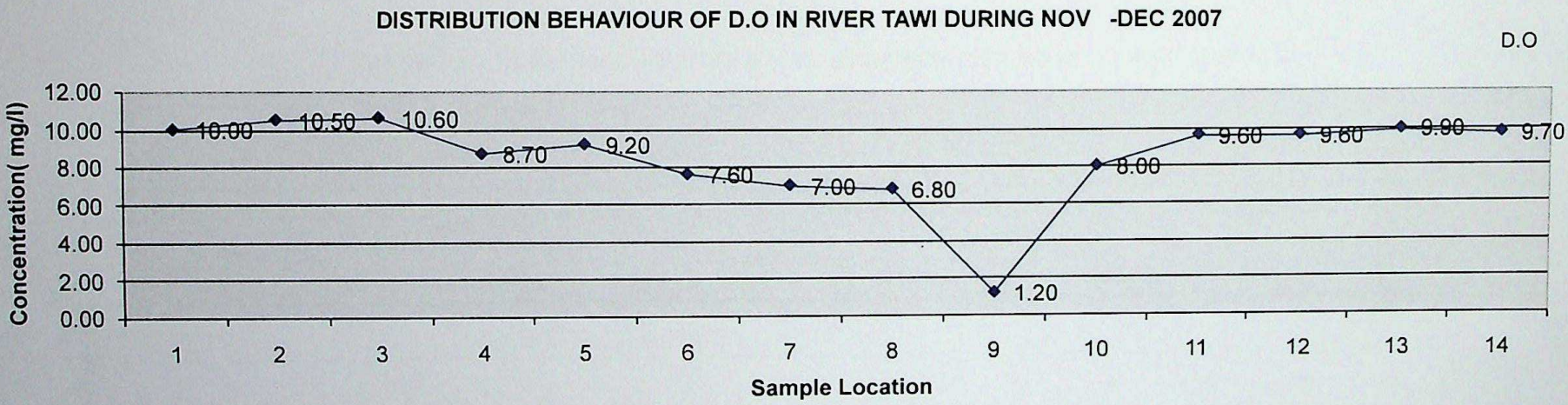
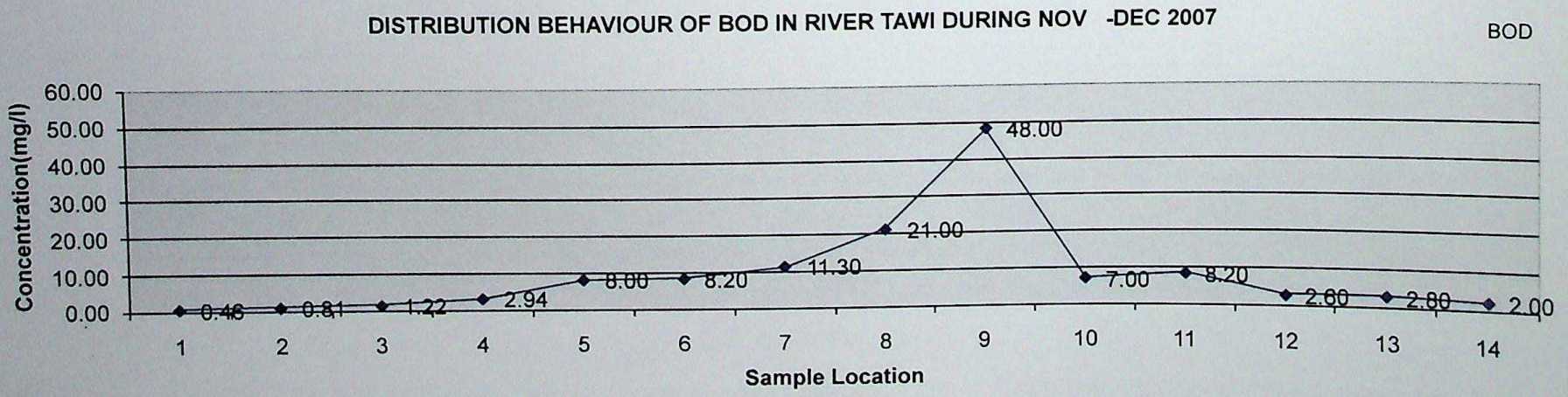
Annexure - 3





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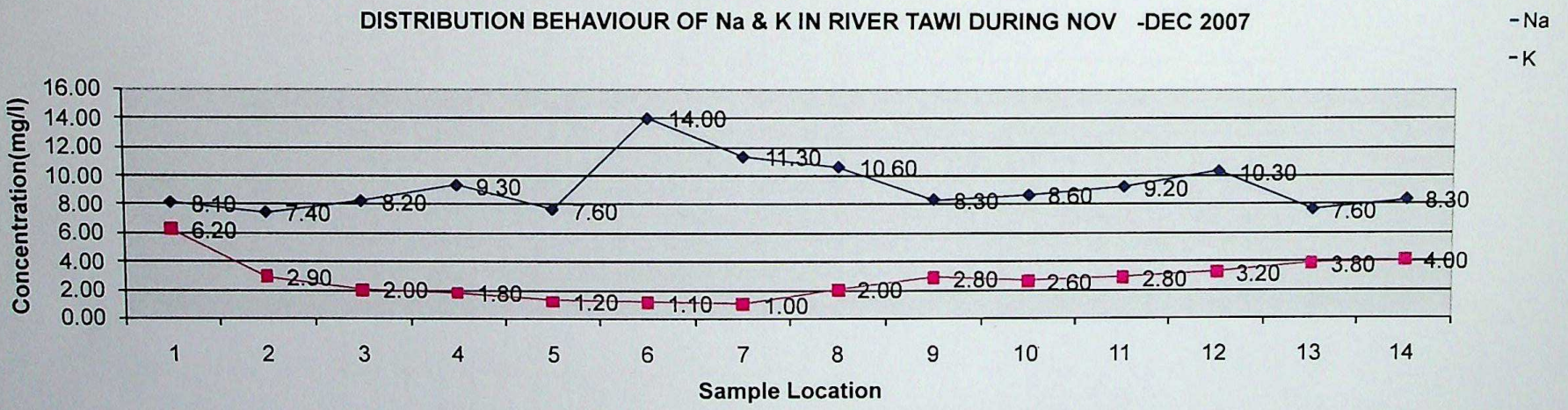
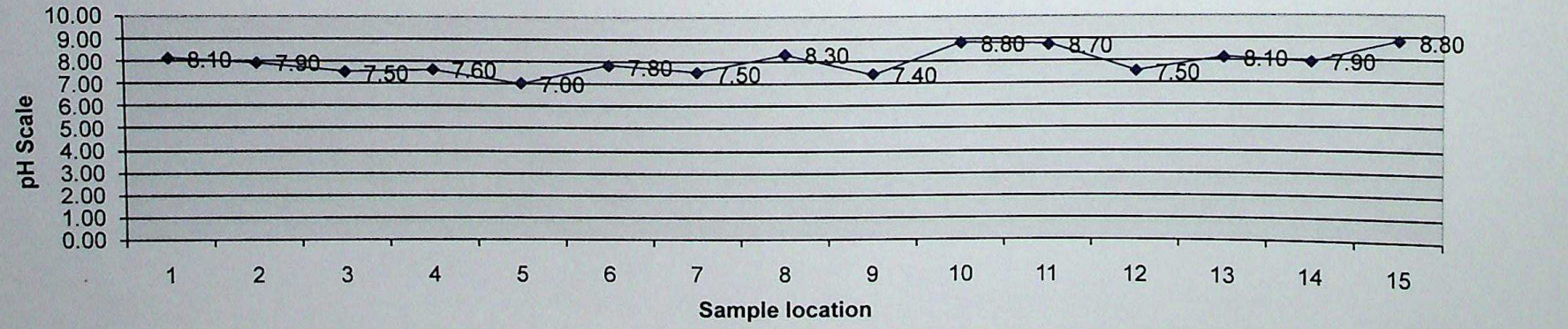
Annexure - 4





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CPCB Classification of Streams

S. No	Designated Best Use	Class of Stream
1	Drinking Water source without conventional treatment but after disinfection	A
2	Outdoor bathing (organised)	B
3	Drinking water with covventional tratment followed by disinfection	C
4	Preopagation of wild-life ,fisheries	D
5	Irrigation , industrial cooling controlled waste water disposal	E

Tolerance Limits in respect of selected pollution characteristics for inland surface waters required for different uses as prescribed by the Bureau of Indian standards (1982)

S.No	Characteristics	A**	B**	C**	D**	E**
1	Dissolved oxygen (DO) mg/l.Min	6	5	4	4	-
2	Biochemical oxygen demand (BOD) mg/l.Max	2	3	3	-	-
3	Total dissolved solids mg/l.Max	500	-	1500	-	2100
4	Chlorides (as cl.mg/l.Max	250	-	600	-	600
5	Colour, Hagen units,Max	10	300	300	-	-
6	Nitrates (as No 3),mg/l.Max	20	-	50	-	2250
7	Conductivity at 250 micro	_	-	-	1000	6.5-8.5
8	PH value	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	-
9	Iron (as Fe) mg/l.Max	0.3	-	50	-	-
10	Fluorides (as F) mg/l.Max	1.5	1.5	1.5	-	-
11	Lead (as Pb) mg/l.Max	0.1	-	0.1	-	-

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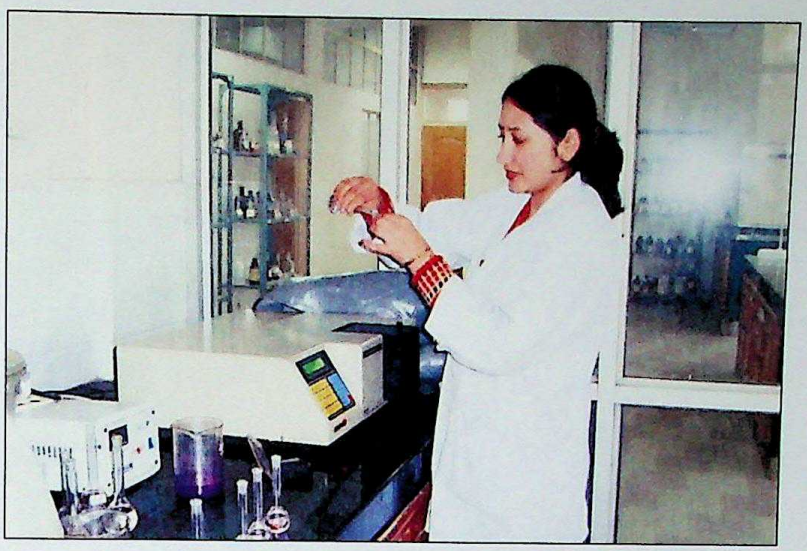
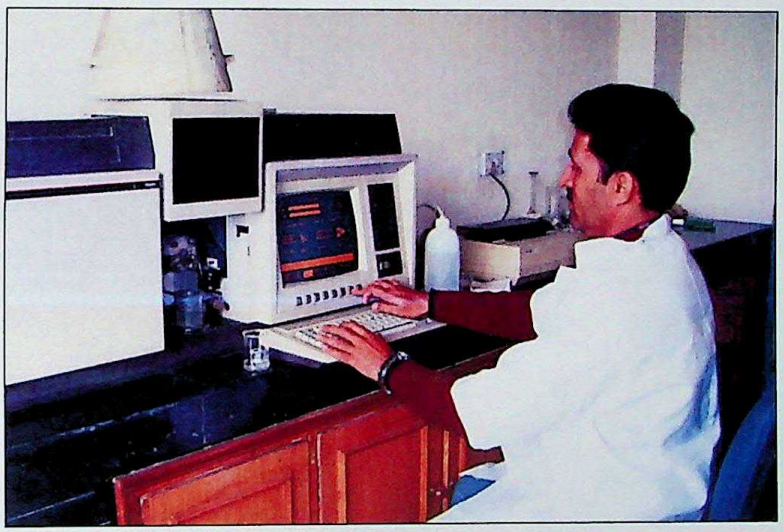
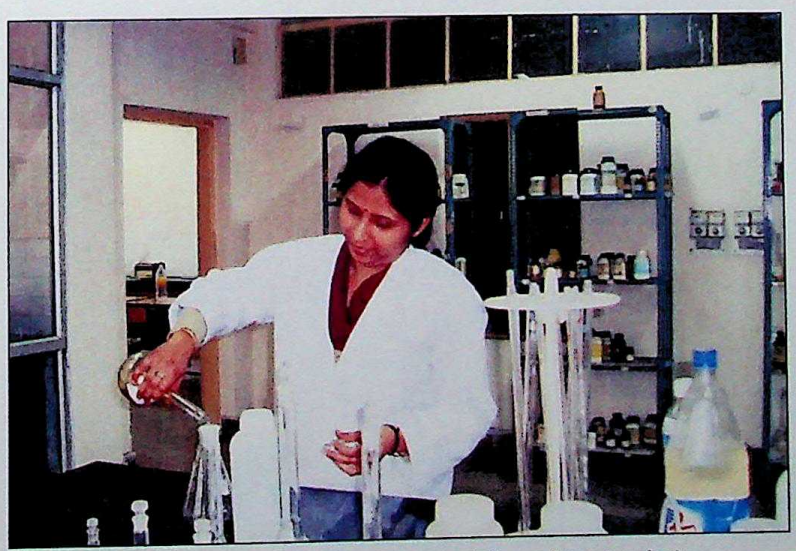


Research Asstt., Anuradha Gupta while making Analysis on Spectro Photometer



Scientist, Dr. Yashpaul Analysing Trace Elements on AAS



Research Assistant Ritu Gupta, while making Analysis

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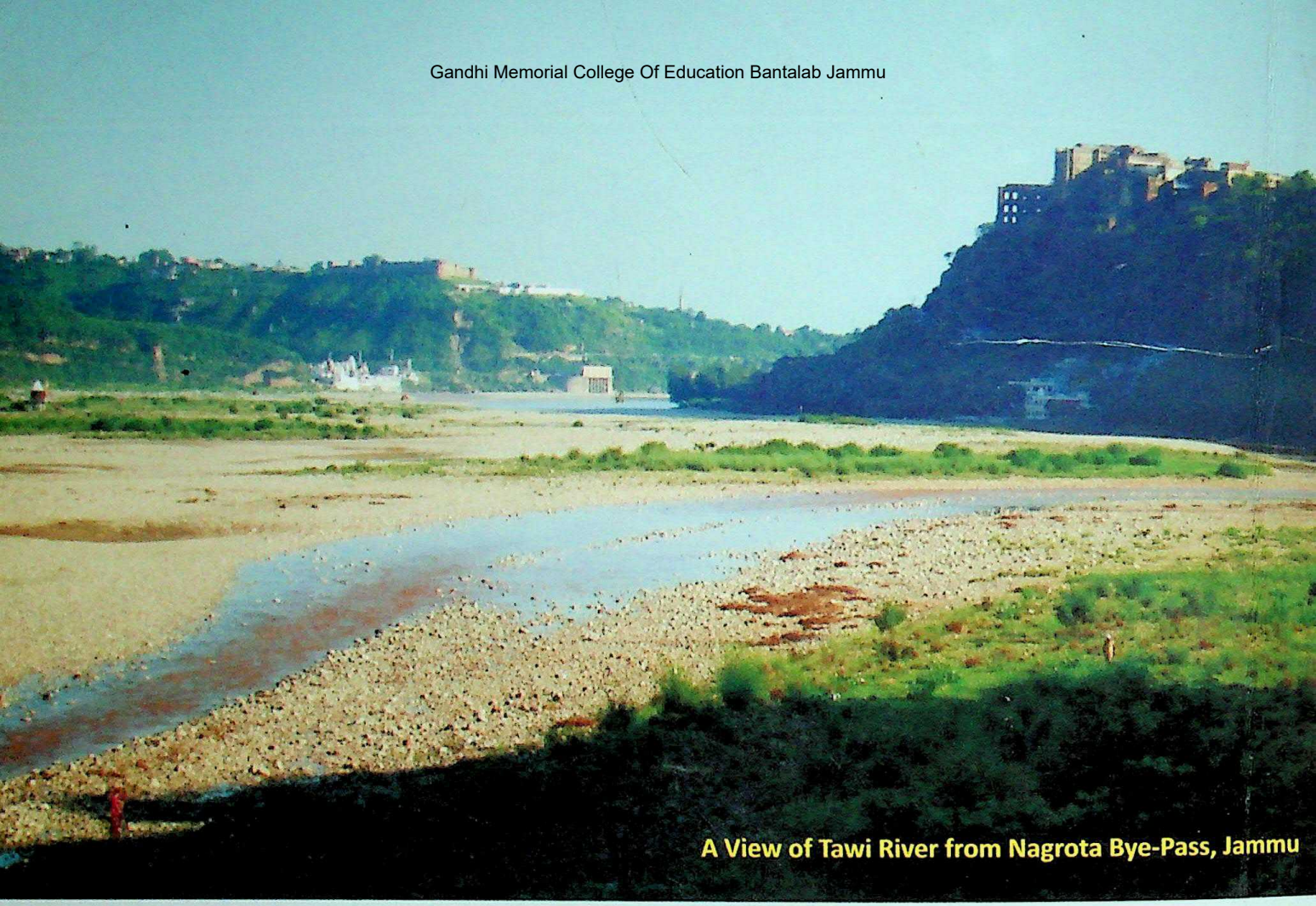
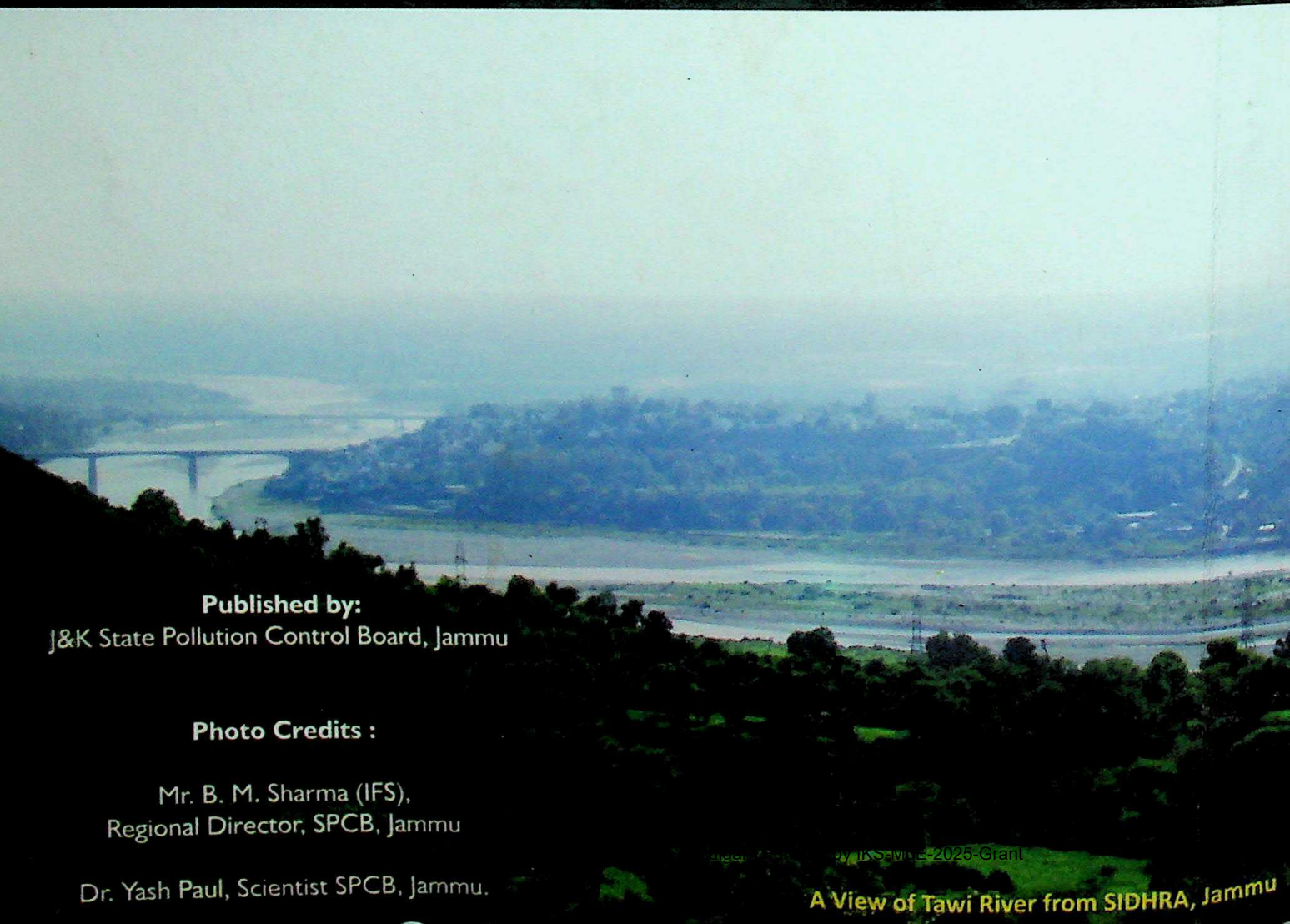


A View of Tawi River from Nagrota Bye-Pass, Jammu



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Regional Director, SPCB, Jammu

Dr. Yash Paul, Scientist SPCB, Jammu.

A View of Tawi River from SIDHRA, Jammu

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